THE CAUSATION OF COLD-WEATHER DISEASES.

AN ATTEMPT TO EXPLAIN THE CAUSATION OF INFLAMMATIONS OF THE AIR-PASSAGES, AND THE SEASONAL SUSCEPTIBILITY TO CERTAIN COMMUNICABLE DISEASES WHICH ARE SHOWN TO BE MOST PREVALENT IN COLD WEATHER.

BY HENRY B. BAKER, M. D., SECRETARY OF THE STATE BOARD OF HEALTH, LANSING, MICH.

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*Mr. President and Members of the Society**:

The facts which I have to present are mostly in the form of tables and diagrams; it follows, therefore, that what I read will be mostly theoretical considerations, designed to make the facts useful, but which remain for you to verify or reject. I trust that they may prove suggestive, and that their probable truth will be stronger near the close than near the beginning of this paper.

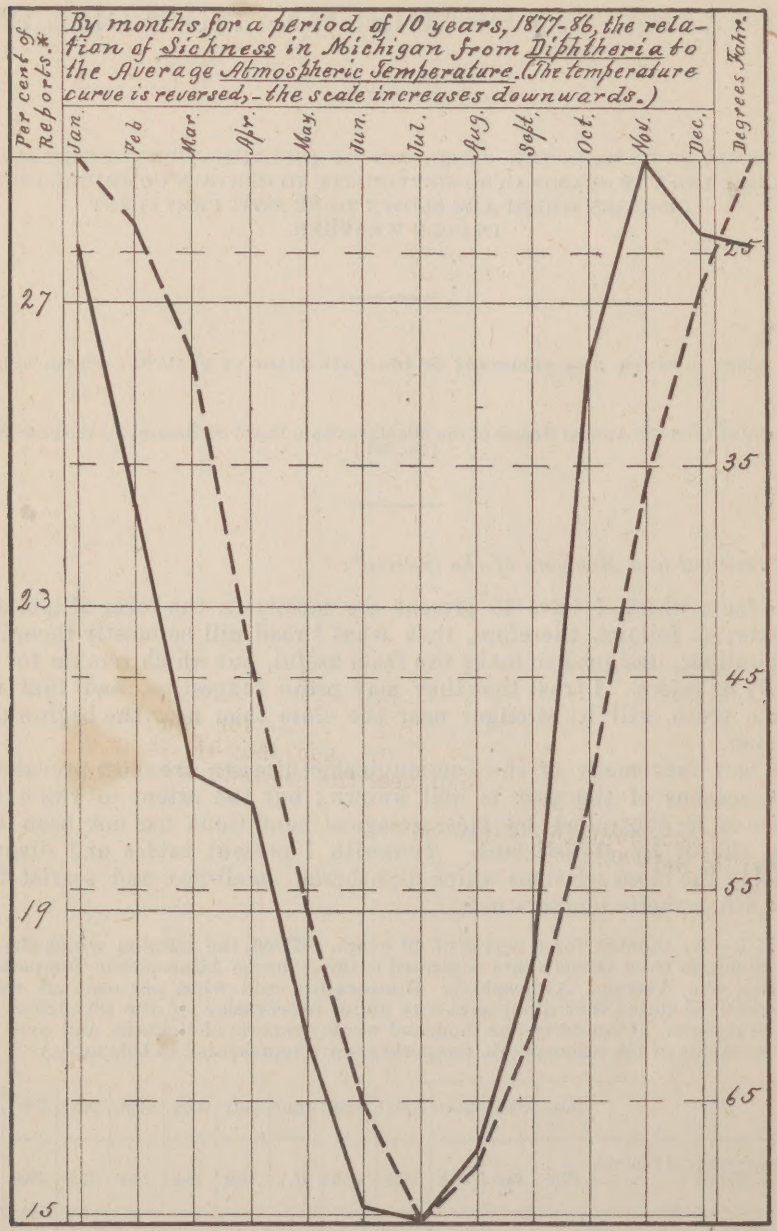
The fact that many of the communicable diseases are most prevalent at certain seasons of the year is well known; but the extent to which their prevalence is controlled by meteorological conditions, has not been thoroughly shown by statisticians. Herewith I present tables and diagrams exhibiting the close relations which diphtheria, small-pox and scarlet fever bear to atmospheric temperature.

TABLE 1.—By months for a period of 10 years, 1877-86, the relation which the sickness in Michigan from DIPHTHERIA sustained to the Average Atmospheric Temperature: Exhibiting the Average Atmospheric Temperature and what per cent all weekly reports received stated that diphtheria was under observation of the physicians who made the reports. (Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this table.)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average per cent. of reports, 10 years, 1877-86	27.7	24.3	20.8	20.4	17.3	15.1	14.9	15.8	18.4	26.2	28.9	27.9
Average Temperature, 10 years, 1877-86	20.56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60

*The first part of this paper was prepared for and read at the meeting of the Michigan State Medical Society at Lansing, May 13, 1887, and although it has been re-written, it still contains traces of its origin which may call for this explanation.

1. Atmospheric Temperature, and Sickness from Diphtheria, in Michigan.

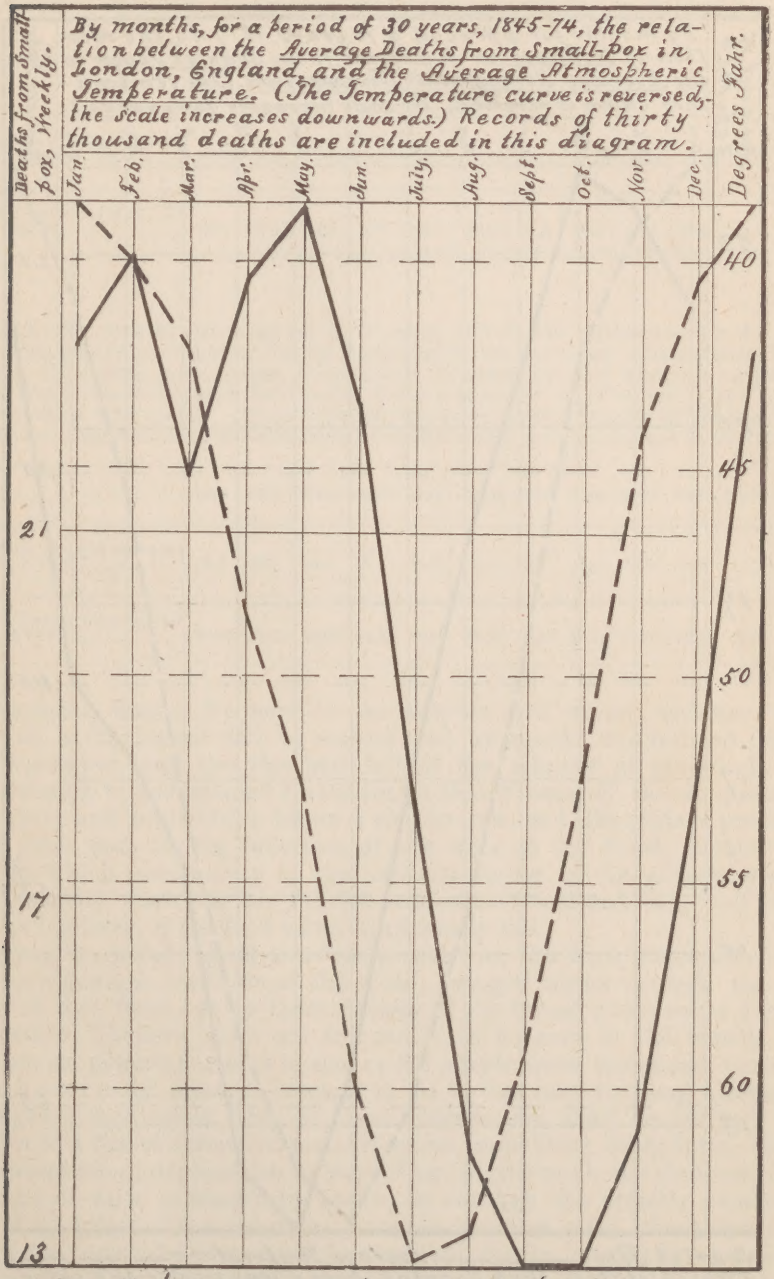


Diphtheria ———. Average Temperature — — —.

*Which stated that diphtheria was under the observation of the physicians who made reports.

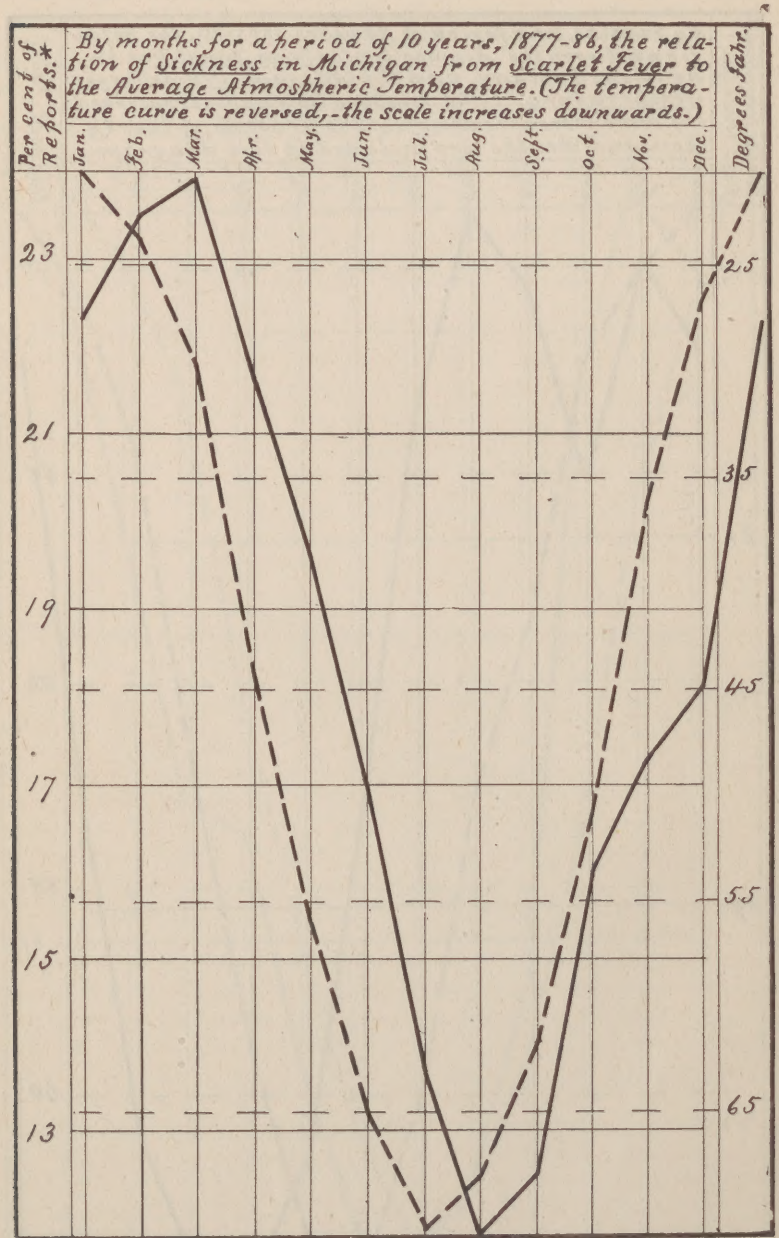
Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this diagram.

Atmospheric Temperature, and Deaths from Small-pox, in London, England.



Small-pox ———. Average Temperature — — —.
Except in a few months the Small-pox follows two months later than the temperature changes.
The line representing Small-pox should follow as long a time later than a line representing its controlling condition as is the average duration of the fatal cases plus the period of incubation?

3. Atmospheric Temperature, and Sickness from Scarlet Fever, in Michigan.



Scarlet Fever _____. Average Temperature — — — —.

*Which stated that Scarlet Fever was under the observation of the physicians who made reports.

Over forty-one thousand weekly reports of sickness and over 190,000 observations of the atmospheric Temperature are represented in this diagram.

TABLE 2.—By months, for 30 years, 1845-74, the relation between the Weekly Average Number of Deaths from SMALL-POX, and the Average Atmospheric Temperature, in London, England. Records of thirty thousand deaths are included in this table.

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average weekly number of deaths, 30 years, 1845-74....	23.00	24.00	21.60	23.75	24.50	22.40	18.00	14.25	13.00	13.00	14.50	18.20
Average Temperature, 30 years, 1845-74.....	38.6	40.1	42.2	48.6	52.7	60.0	64.2	63.5	59.1	52.2	44.2	40.5

TABLE 3.—By months for a period of 10 years, 1877-86, the relation which the sickness in Michigan from SCARLET FEVER sustained to the Average Atmospheric Temperature: Exhibiting the Average Atmospheric Temperature and what per cent of all weekly reports received stated that Scarlet Fever was under observation of the physicians who made the reports. (Over forty-one thousand weekly reports of sickness, and over 190,000 observations of the atmospheric temperature are represented in this table.)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average per cent of reports, 10 years, 1877-86.....	22.3	23.5	23.9	21.6	19.6	17.0	13.7	11.8	12.5	16.0	17.3	18.1
Average Temperature, 10 years, 1877-86.....	20.56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.60

DIPHTHERIA is most frequent in the autumn and winter, accompanying somewhat, in its rise and fall by seasons and by months, the fall and rise of the temperature, and the rise and fall of the velocity of the wind. In papers relating to pneumonia* I have shown that diseases of the air-passages (pneumonia and bronchitis) follow a similar law, and that this is probably due in great part to the influence of the salts of the blood, notably the chlorides, which accumulate in the mucous lining of the air-passages in undue quantity when the air inhaled is unusually cold and dry, and especially, as I believe, if the food eaten is unusually salt.

As in scurvy, purple spots sometimes occur on the legs, supposed to be due to an abnormal condition of the blood, brought about through the ingestion of salt foods, so in those diseases of the throat which occur during cold weather, I believe there are frequently to be seen in the mouth and fauces purple patches; and as in scurvy the purple spots sometimes ulcerate or slough over small areas, so it seems to me in the sore throats, ulceration or sloughing may occur. So, if these observations shall be verified, the causation of a throat disease in some respects resembling diphtheria, seems to be susceptible of explanation by supposing that through the abnormal displacement of salts necessary to health, or through the directly poisonous action of an excess of the chlorides (such as common salt), there occurs a death of the superficial tissue which is exposed to the constantly increasing quantity of salt, due to excessive evaporation of the natural moisture of the

*One of these papers was published in the annual report, Michigan State Board of Health, for 1886, pages 246-324.

parts. Malignant diphtheria is sometimes characterized by the death of a portion of the mucous membrane. But supposing a membranous slough, caused in the manner I have suggested; as soon as a slough has occurred, there is opportunity for the rapid reproduction of bacteria, which, during the life of the mucous membrane, were unable to gain ascendancy. Under such circumstances it seems probable that ordinary septic organisms, will multiply, and their poisonous products may be absorbed into the circulating blood. Is it not possible that a sore throat having the apparent characteristics of diphtheria, and followed by the phenomena of septicemia, may thus be caused (in a person whose blood is abnormally saline, and whose throat is tender), by the continued exposure to the inhalation of air unusually cold and dry, the constant evaporation of the fluids in the posterior nares and fauces, leaving behind a constantly increasing proportion of the salts of the blood, notably common salt, this salt permeating the mucous membrane, displacing other normal salts which should remain present, and these chlorides in excess acting as an irritant poison, capable, when sufficiently concentrated in the tissue, of causing the death of the tissue?

It seems probable that a false membrane may be formed by the exudation of fibrinous material in accordance with a law of osmosis, which is stated by Prof. John C. Dalton, as follows:

"But a substance like albumen, which will not pass out by exosmosis toward pure water, may traverse a membrane which is in contact with a solution of salt. This has been shown to be the case with the shell membrane of the fowl's egg, which, if immersed in a watery solution containing from 3 to 4 per cent of sodium chloride, will allow the escape of a small proportion of albumen. Furthermore, if a mixed solution of albumen and salt be placed in a dialysing apparatus, the salt alone will at first pass outward leaving the albumen; but after the exterior liquid has become perceptibly saline, the albumen also begins to pass in appreciable quantity." *

What determines whether an exudate shall be pultaceous, leathery, or croupous, I have no new evidence to offer. Neither have I new evidence on what causes or constitutes the contagious element. Evidence already on record seems to indicate that there are exudates which do not contain specific germs, or at least are not capable of communicating a serious disease, and that there are exudates which do contain specific germs, or at least are capable of communicating diptheria to persons *supposed* to be in health—that there is croup which is *not* diphtheritic, and that there is croup which *is* diphtheritic. The term diphtheria, however, is differently employed—by some being restricted to cases in which there is a false membrane, by some to cases in which there is sloughing of the real membrane, while by others it is made to include all cases which are communicable, irrespective of the character of the exudate or of the inflammation. I think this last is the view most conducive to the public health. And, since there is no certain way in any first case whereby a physician can always tell whether or not the case is one of those which tends to communicate diphtheria, there seems to be need for a plan of action, for the public safety, which shall recognize the difficulties which have been met with. A few years since the State Board of Health in this State passed preambles and resolutions which, although familiar to some of you, may be of interest and of utility in this connection. They are as follows:

*Dalton's Physiology, 6th Edition, Phila., 1875, p. 363.

Whereas—It is often difficult to recognize mild cases of diphtheria, or to distinguish such cases from a simple tonsilitis, pharyngitis or laryngitis, and

Whereas—Such mild cases of diphtheria often communicate a dangerous and fatal form of diphtheria;

Resolved—That it is the duty of physicians and householders in reporting diseases dangerous to the public health, and of local health authorities in their efforts to restrict such diseases, in every case to give to the public safety the benefit of the doubt;

Resolved—That suspected cases of dangerous diseases should be reported and precautionary measures should be taken.

SMALL-POX.—From the diagram I offer, page 199, it may be seen that the deaths from small-pox bear a quantitative relation to the atmospheric temperature, rising after the temperature falls, and falling after the temperature rises. Its changes follow about two months after the temperature changes, possibly a little less than two months (the unit of the time in my diagram being one month), but certainly more than a month and a half. As the period of incubation probably averages less than a half of a month, and the average duration of the fatal cases is probably less than a month, is it not probable that the effects of low temperature are cumulative, the greatest effect being only after exposure to the inhalation of cold air for a considerable period of time? It is conceivable that the increase of small-pox or the deaths from* small-pox in the cold weather may, in some manner, be due to a lowering of the temperature of the blood of the body; but in that case the effect would not be deferred as it is shown to be by the diagram, and it does not seem so reasonable as that it is due to influences on the susceptibility of the air-passages to the reception and entrance of the virus. The removal of water from the body by way of the lungs, in excessive quantity, tends toward increasing the salinity of the fluids which constantly moisten the air-passages and air-cells. According to Prof. Dalton (quoted previously) *albuminous* constituents of the blood should pass out from the blood-vessels to such a saline fluid whenever it contains about 4 per cent of sodium chloride (common salt).

If through the continuance of rapid evaporation from the air-passages the salts of the blood tend to collect in the air-cells and the air-passages, and if when this salt reaches 4 per cent of the moisture which is always present, the albuminous constituents tend to pass out into the air cells and air-passages, the exudations which there occur after exposure to cold seem to be explained; and at the same time it seems probable that a virus like that of small-pox—capable of reproduction in the serum of the blood, may in such an exudate find a *nidus* more favorable to its lodgement than on the mucous membrane in its more normal condition. It seems to me, then, that this is the explanation of the reason why small-pox is, at nearly every season of the year, quantitatively proportional to the temperature of the atmosphere; it is because the absolute humidity of the atmosphere is controlled by the temperature, and because, other things being equal, the warmer the atmosphere the moister it is, and the less tendency there is toward the exudation of plastic material in the air-passages; and the colder the atmosphere the drier it is, and the greater the tendency toward exudations and ulcerations in the air-passages.

The extent to which moisture is generally exhaled from the air-passages is appreciated by all of us, but it may not always be held in mind how much greater the quantity is in cold weather than in warm weather. This may be

*The increase of deaths is so marked and regular that I infer there is an increase in the cases. The evidence of epidemics seems to show the same.

appreciated by remembering that air saturated with vapor will contain at zero F. only half a grain of water, at 32 degrees two grains, at 70 degrees eight grains, while at 98 degrees—which is about the temperature at which air is exhaled—it will contain 18.69 grains. While, therefore, each cubic foot of air inhaled at 70 degrees F. will, when exhaled, abstract about ten and one half grains of vapor of water, if inhaled at zero it will abstract about eighteen grains.

A difference of seven and a half grains of water per cubic foot of air inhaled, seems a small difference, yet allowing 18 respirations per minute of twenty cubic inches of air each, there are 300 cubic feet of air inhaled daily, and a difference of 1,250 grains of water per day. Supposing each thousand parts to contain 3 parts of chloride of sodium,* less than four grains of salt per day would be left by the evaporation. However there are other facts (as the absence of the chlorides from the urine during the onward progress of pneumonia, and other considerations connected with the laws of osmosis) which support the belief that such a movement of the chlorides once started tends to continue until all that are available have been thrown out into the exudate. Probably one reason why this is so is that, as stated by Prof. Dalton,† "As a general thing, if the liquids employed be water and a saline solution, endosmosis is more active, the more concentrated is the solution in the endosmometer; that is, a larger quantity of water will pass inward toward a dense solution than toward one which is dilute." * * *

"When an animal membrane, accordingly, is placed in contact with two different liquids, it absorbs one of them more abundantly than the other; and if that which is absorbed in the greatest quantity is also readily diffused into the liquid on the opposite side, a rapid endosmosis will take place in that direction, and a slow exosmosis in the other. Consequently the least absorbable fluid increases in volume by the constant admixture of that which is taken up more rapidly."‡ If through evaporation, the fluid in the air passages and in the lungs becomes a more "dense solution" than the blood plasma in the capillaries, and consequently, the "least absorbable fluid," the tendency is then toward continued exudation into the air-passages and air cells in the lungs.

It has recently been shown by B. J. Stokvis‖ that in fatal poisoning of dogs and rabbits by the chlorides of sodium and potassium a prominent pathological condition is "a never failing" œdema of the lungs. This seems to prove experimentally one point which I had worked out theoretically,§ and is in harmony with the paragraph next preceeding this.

Scarlet Fever.—By the diagram which I present to you, page 200, it may be seen that the sickness in Michigan from scarlet fever appears to follow the temperature, falling after the temperature rises in the spring, and rising after the temperature falls in the autumn, the sickness changes averaging about one month later than the temperature changes. The probable reason for this (delay in the sickness changes) seems to me to be that the average duration of the sickness, plus the period of incubation, is more than half a month, and as the unit of time employed in the diagram is one month, the changes in the sickness appear to follow one month later than the tempera-

* Page 47, Dalton's Physiology, 6th Edition, 1875.
† Human Physiology, p. 362, 6th Edition, Philadelphia, 1875.
‡ Page 363, Dalton's Physiology.
‖ Archiv für Experimentelle Pathologie und Pharmakologie, Band 21, 3d Heft.
§ Page 302, Report Michigan State Board of Health, 1886.

ture changes. If this is the correct explanation, it will appear from the diagram that the average duration of the disease is greatest in the winter months; at least the maximum sickness is shown to be in March—two months later than the lowest temperature, which would thus appear if the average duration of the sickness, plus the period of incubation, was more than one month and a half. But I have found that the curves for non-contagious diseases—influenza, tonsilitis and bronchitis—which also are controlled by the temperature, do not lag two months behind the temperature at any season of the year. Curves for these diseases usually follow about one month later than the temperature changes, as shown by diagrams Nos. 4, page 207, 5, page 208, and 6, page 209. It would seem as if the average duration of scarlet fever in winter was longer than that of bronchitis, or, what to me is more probable, that the susceptibility to scarlet fever is greatest a certain time *after* exposure to the inhalation of cold dry air. The explanation seems to me to be the same as I have already stated with reference to small-pox and diphtheria, namely, the plastic exudation, thrown out in the air-passages after inhalation of cold dry air, has resulted in an accumulation of a sufficient quantity of the non-volatile salts of the blood; and the ulcerations which I have supposed may occur as a consequence of long-continued inhalation of cold dry air.

GENERAL CONSIDERATIONS.

The facts which seem to prove that the rises and falls of diphtheria, small-pox, and scarlet fever are (directly or indirectly) almost absolutely controlled by the atmospheric temperature, have now been set forth, as also have some of the facts and considerations which seem to prove that such control is indirect by controlling the quantity of vapor of water inhaled.

The foregoing evidence is greatly strengthened if we add to it the facts concerning the relations of meteorological conditions to certain other diseases (of the throat and air-passages) not known to be contagious. Therefore, tables 4, 5, and 6, and the corresponding illustrative diagrams, exhibiting the rises and falls of the atmospheric temperature and of the three diseases—influenza, tonsilitis, and bronchitis, as shown by the meteorological and sickness statistics for 8, 9, and 10 years, collected by the Michigan State Board of Health are here given. The diagrams indicate that each one of these diseases is controlled by the temperature of the atmosphere.

TABLE 4.—*Atmospheric Temperature, and Sickness from Influenza in Michigan.*

	Year	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of influenza.....	40	55	61	59	52	38	28	20	21	29	33	41	48
Av. At. Temp. Deg. F.	46.11	20.56	23.62	29.80	44.33	56.08	65.10	70.52	68.14	61.67	50.83	36.04	26.50

TABLE 5.—*Atmospheric Temperature, and Sickness from Tonsilitis in Michigan.*

	Year	Jan.	Feb.	Mar.	April	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of tonsilitis	49	55	62	61	53	47	42	33	32	37	45	55	60
Av. At. Temp. Deg. F.	45.39	19.91	21.77	28.82	43.04	55.98	64.79	69.78	66.25	61.11	50.68	35.56	25.82

TABLE 6.—*Atmospheric Temperature, and Sickness from Bronchitis in Michigan.*

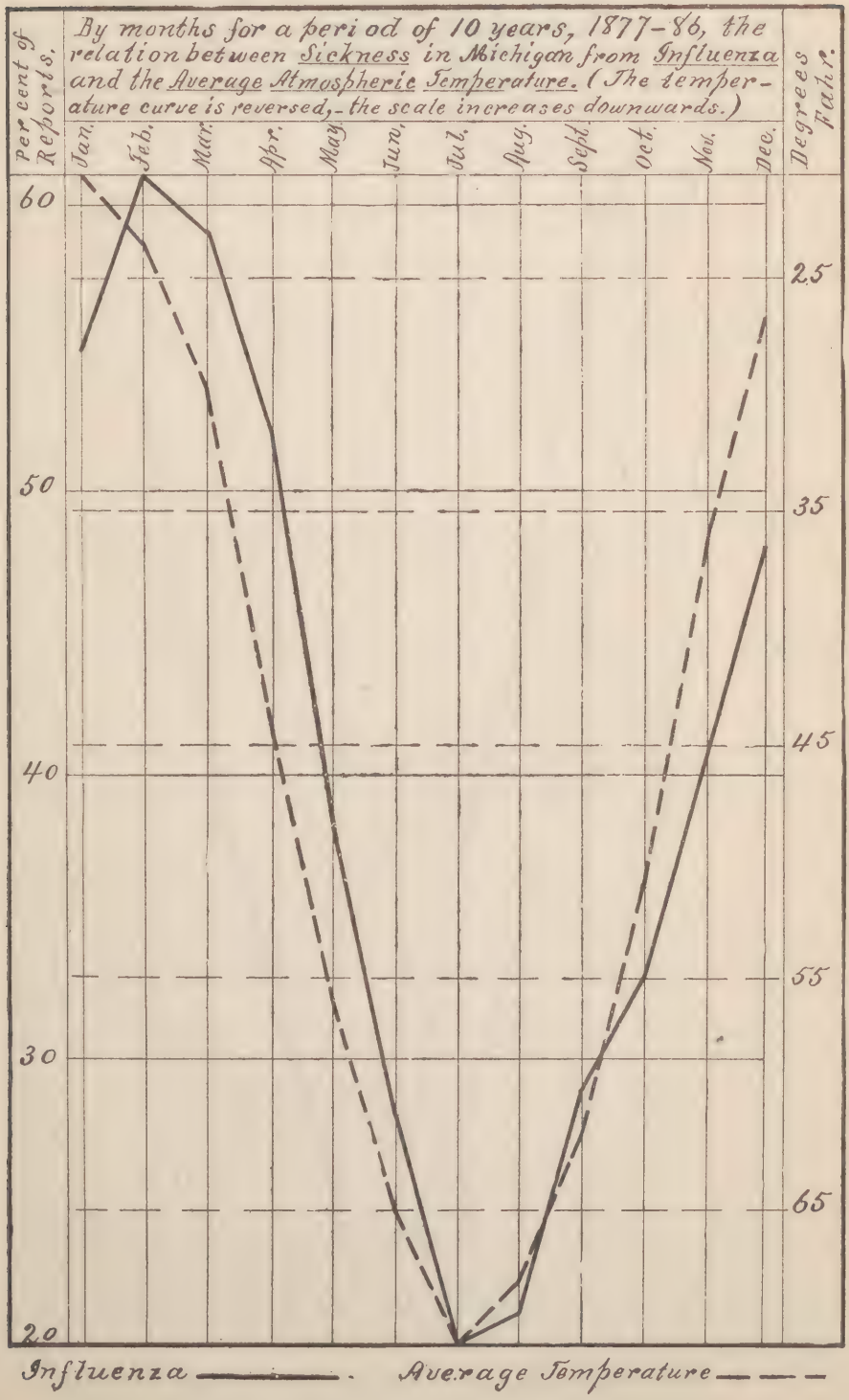
	Year	Jan.	Feb.	Mar.	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Per cent of weekly reports stating presence of bronchitis	62	77	78	77	72	61	54	43	41	49	55	67	72
Av. At. Temp. Deg. F.	46.25	20.77	28.89	29.76	44.14	56.23	65.30	70.73	68.23	61.73	50.72	36.23	27.28

Having learned that it is true that these diseases are so dependent upon the temperature of the air inhaled, the next question is *how* does the inhalation of cold air favor the causation of diseases of the throat and air-passages? In my opinion, the explanation has been given in this article, in connection with what has been said of the causation of diphtheria, small-pox, and scarlet fever. However, because these last-mentioned diseases are contagious, it does not necessarily follow that either influenza, tonsilitis, or bronchitis is contagious. Each of these diseases is an inflammation of the mucous membrane, brought about by some irritant which is either very generally distributed in the atmosphere, or very generally present in or upon the mucous membrane in the throat and air-passages. The irritant cause of each of these diseases is quantitatively proportioned to the temperature of the atmosphere. This is plainly indicated by the evidence herewith presented, as must be admitted by any one who will carefully examine the evidence, especially that in the diagrams. These inflammatory but non-contagious diseases are shown to be even more uniformly controlled by the atmospheric temperature than the contagious diseases are. The contagious diseases seem to follow these non-contagious inflammatory diseases of the throat and air-passages, and the reasons for this have, I think, been explained. I can think of no non-contagious irritant cause of each of these inflammatory diseases of the mucous membrane, more likely to be (as this cause is) quantitatively proportioned to the temperature of the atmosphere than is the non-volatile salt deposited in and upon the mucous membrane in the throat and air-passages through the evaporation which constantly occurs so long as life, or at least respiration continues, and which, other things being equal, it seems plain must be deposited there in quantities proportioned to the absolute dryness of the atmosphere. As explained on a preceding page, in connection with the subject of small-pox, the absolute humidity of the atmosphere is controlled (as to its maximum at least) by the temperature. Cold air is always, necessarily, dry air.*

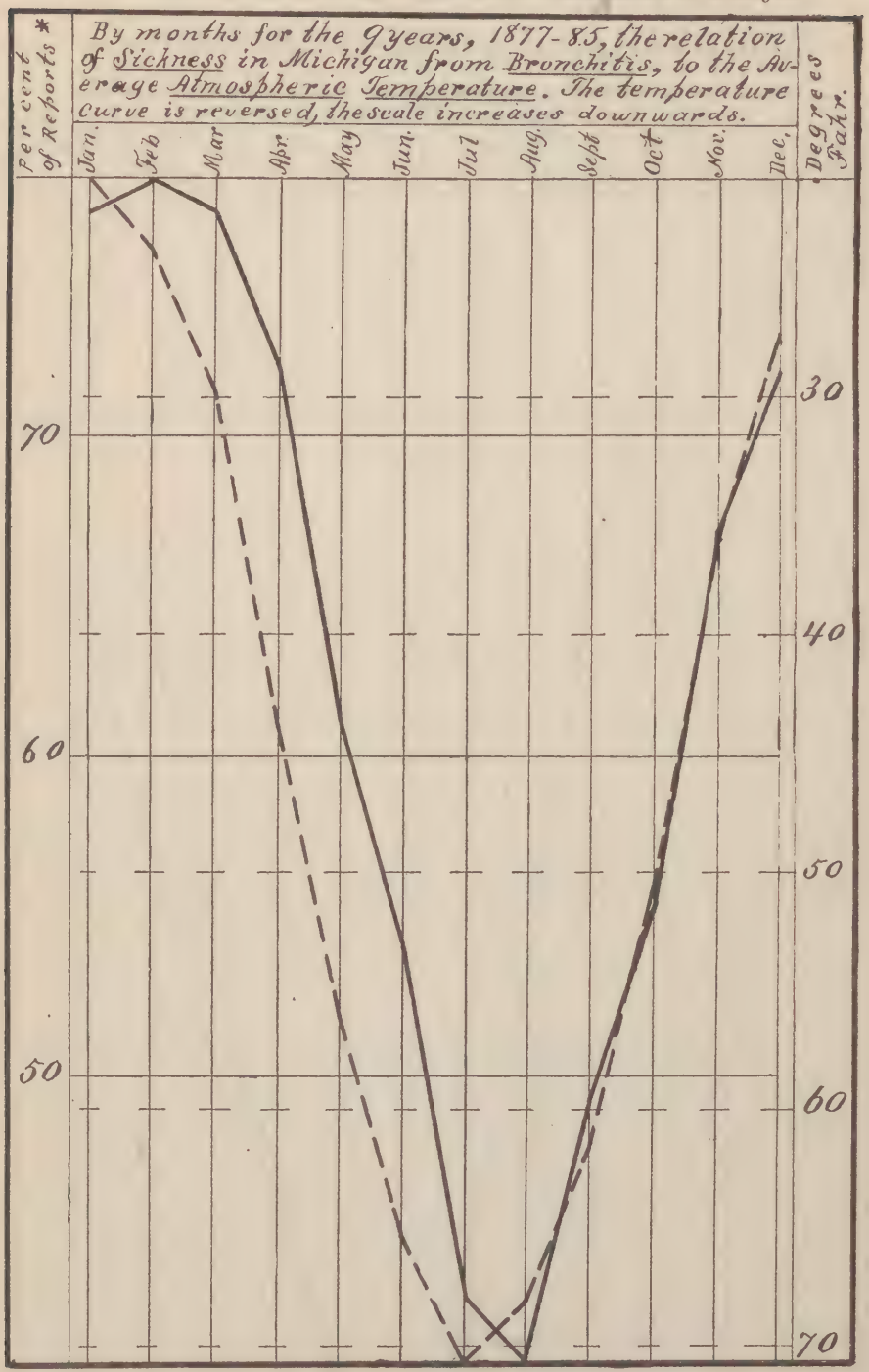
My belief is that the non-volatile salts—such as sodium chloride, potassium chloride, etc., (possibly including urea and uric acid) left in or upon the

* This statement is easily verified by consulting any good elementary work on meteorology.

4. *Atmospheric Temperature, and Sickness from Influenza, in Michigan.*



5. *Atmospheric Temperature, and Sickness from Tonsilitis, in Michigan.*

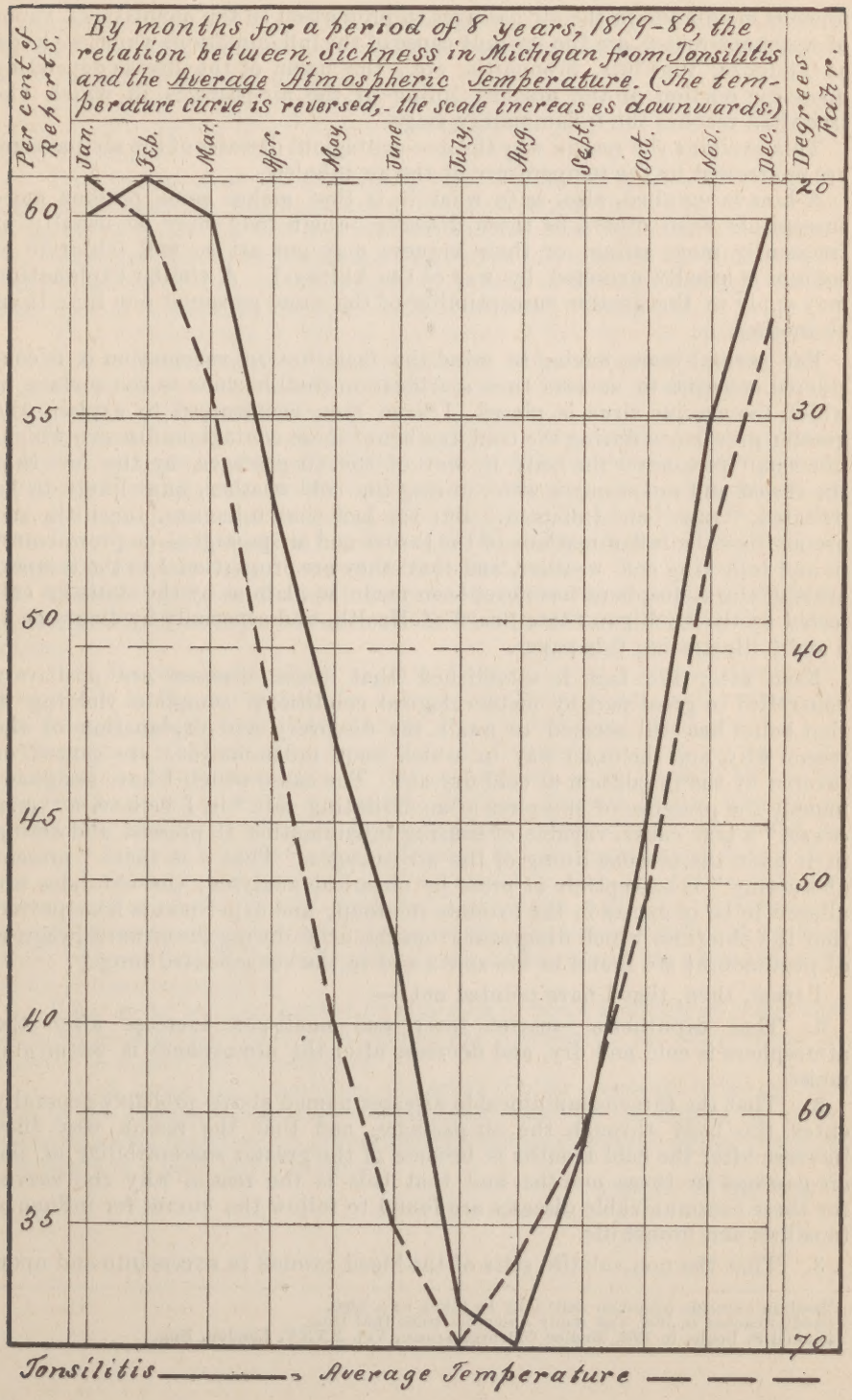


Bronchitis ————. Average Temperature — — —.

* Indicating what per cent of all reports received, stated the presence of Bronchitis then under the observation of the physicians reporting.

Over 35,000 weekly reports of sickness, and about 173,000 observations of the atmospheric temperature are represented in this diagram.

6. *Atmospheric Temperature, and Sickness from ~~Bronchitis~~ Tonsilitis, in Michigan.*



mucous membrane in the air-passages in proportion to the quantity of vapor of water abstracted, are the irritant cause of the inflammations which we know as influenza, tonsilitis, bronchitis, etc., the name of the disease depending upon the portion of the mucous lining of the air-passages in which the irritation reaches the inflammatory stage.

This explains the reason why the non-contagious diseases of the air-passages are controlled by the temperature of the air inhaled.

A hint is supplied, also, as to what it is that makes some persons more susceptible than others to these diseases,—their food may be usually or frequently more saline, or their kidneys may not act so well (chloride of sodium is usually excreted by way of the kidneys). A similar explanation may apply to the greater susceptibility of the same person at one time than at another.

For several years, having in mind the fact that in vaccination it is considered essential to success that scarification shall be done to the surface in which the vaccine virus is placed, I have been accustomed to explain the greater prevalence during the cold weather of those contagious diseases which, like small-pox, enter the body by way of the air-passages, by the fact that the throat and air-passages were, during the cold weather, most likely to be irritated, "raw," and inflamed. But the fact that influenza, tonsilitis, and bronchitis—the inflammations of the throat and air-passages—do prevail most in and following cold weather, and that they are proportional to the temperature of the atmosphere has never been made so plain as by the statistics collected by the Michigan State Board of Health, and especially by diagrams 4, 5 and 6 illustrating this paper.

Even after the fact is established that these diseases are positively controlled in great part by meteorological conditions, complete yielding to that belief has still seemed to await the discovery and explanation of the reason why, and the exact way in which such inflammations are caused or favored by the inhalation of cold dry air. The cause which I have assigned, namely the presence of an excess of an irritating salt,* is, I believe, a "*vera causa*," a true cause, capable of causing inflammation if present and acting in or upon the mucous lining of the air-passages. That it is there "present and acting" is susceptible of proof by chemical analyses; the chlorides are alleged to be in excess in the exudate in croup; and experiments have proved that the chlorides which disappear from the urine during the onward progress of pneumonia† are found in the sputa and in the consolidated lung.‡

I trust, then, that I have pointed out:—

1. That diphtheria, scarlet fever, and small-pox increase after the atmosphere is cold and dry, and decrease after the atmosphere is warm and moist.

2. That the three communicable diseases named above probably generally enter the body through the air-passages, and that the reason why they increase after the cold months is because of the greater susceptibility of the air-passages in those months, and that this is the reason why the curves for these communicable diseases are found to follow the curves for influenza tonsilitis and bronchitis.

3. That the non-volatile salts of the blood exuded in excess into and upon

*Sodium chloride (common salt) may be taken as a type.
†Redtenbacher in 1850, and many observers since that time.
‡Lionel S. Beale, in 1852, Medico Chirurg. Trans., Vol. XXXV, London, Eng.

the mucous surfaces of the air passages are capable of leading to an inflammation which is called "influenza," "tonsilitis," or "bronchitis," according to the portion of the respiratory tract involved.

4. That, other things being equal, the non-volatile salts are left by evaporation on the mucous lining of the air-passages, in proportion to the dryness of the air inhaled.

5. That inasmuch as the absolute dryness of the air ordinarily depends upon its coldness, the inflammations of the air-passages should be expected to rise as they do after the cold dry weather, and fall after warm moist weather.

6. That the non-volatile salts are likely to be in excess in the blood under some conditions of diet, or non-action of the skin or kidneys through which, under normal conditions, they pass out of the body. Therefore,

7. That certain kinds of diet, or non-action of the skin or kidneys, may predispose to inflammation of the air-passages, and consequently to any communicable disease, which enters the body by way of the air-passages, to which the person may be susceptible.

8. That, aside from the cause herein assigned (non-volatile salts), no other known cause, capable of causing inflammation of the air-passages, is "present and acting" in proportion to the coldness and dryness of the atmosphere.

In connection with the foregoing, a few supposed facts, not entirely outside of the province of this paper, should be held in mind, because they tend to modify the force of the evidence herein presented:—

a. Vaccine virus (and therefore, possibly the virus of the cold-weather communicable diseases) retains its vitality longer in cold than in warm weather.

b. The danger of contracting a communicable disease is probably increased by exposure to the contagium in a badly-ventilated room, and rooms are most frequently badly ventilated during the cold weather.

But neither of these two statements is known to be true so nearly in proportion to the temperature of the atmosphere as to explain the close correspondence with which the curves of these diseases follow the curves representing the temperature of the atmosphere. And since it is proved in this paper that the ordinary inflammations of the air-passages also follow the rises and falls of the atmospheric temperature, and are believed to be non-contagious, their equally close correspondence with the temperature changes cannot be accounted for by the varying degrees of vitality of a virus, nor by bad ventilation, especially as they are so frequently traced to exposure to cold outdoor atmosphere.

9. That so far as is yet proved by statistics of large numbers of cases, the strongest controlling cause of inflammatory diseases of the air-passages is exposure in a cold, dry atmosphere.

10. That, excepting inoculation and other similar exposure to the specific cause of the disease, the strongest controlling cause of the spread of those communicable diseases which generally enter the body through the air-passages is exposure in a cold, dry atmosphere.

HENRY B. BAKER.